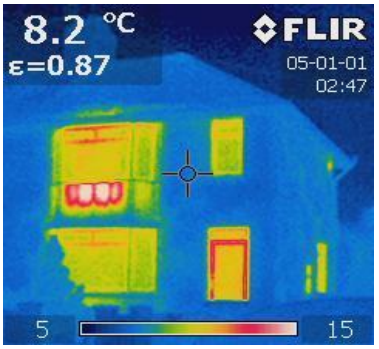
The CAG Project Guide to: Running a thermal imaging project

This guide was compiled in 2018 making use of resources created by several Community Action Groups: Sustainable Didcot, Greening Chinnor, Low Carbon East Oxford, Low Carbon Headington and Local Environmental Action Florence Park (LEAF). The CAG Project would like to thank all contributors for sharing their resources. The creation of this guide was supported through funding from Low Carbon Hub.



This Detailed Interpretation Guide is an excerpt from the larger project guide available at https://shorturl.at/3NRWM or https://www.cagoxfordshire.org.uk/project-resources.

1. Introduction

What is thermal imaging?

Thermal imaging or 'thermography' works by detecting the infra-red light emitted by a building and using it to determine the temperature of the surface of walls, windows, doors, roofs etc. Objects at different temperatures emit varying amounts of infra-red light and a thermal imaging camera translates these differences into an image with different colours representing cool to hot temperatures.

Why do thermal imaging?

Thermal imaging is a strongly visual way of engaging with people in your local community. By providing people with images of their own homes, the issue of energy efficiency becomes less abstract and more immediately relevant to them. A thermal image of the outside surface of a house can show areas which are conducting heat from the inside to the outside of the house, helping to identify:

- Draughts
- Whether cavity wall and loft insulation is patchy, missing or has been bridged by a conducting structure.
- Poor or broken seals around windows and doors
- Poorly insulated (e.g. single glazed) windows

Information and energy-saving advice given alongside the survey may help the homeowners, landlords or residents make improvements which will:

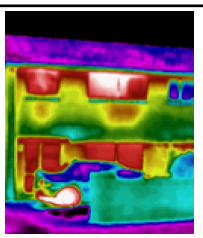
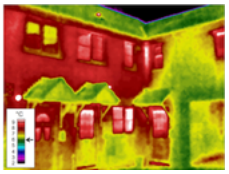
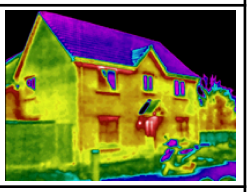
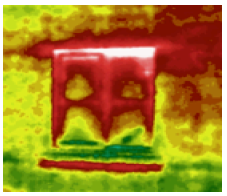
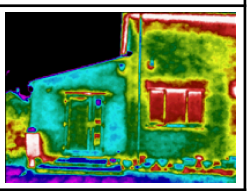
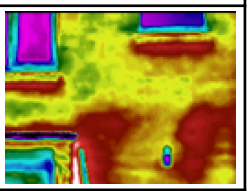
- Save them money on their bills
- Make their homes more warm and comfortable
- Reduce carbon emissions

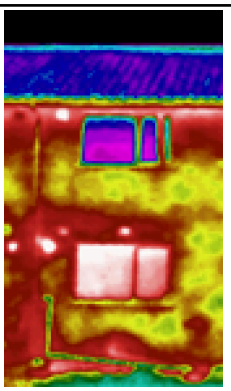
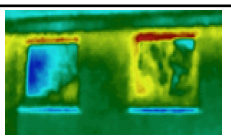
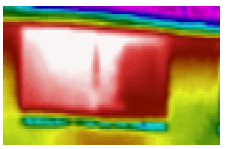
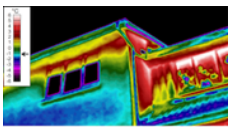
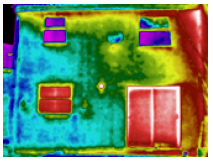
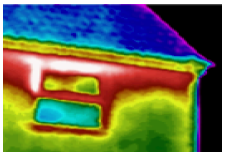
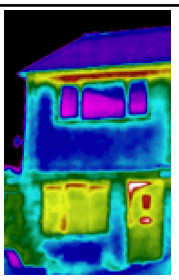
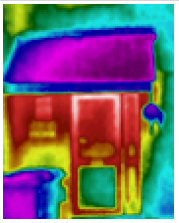
General points

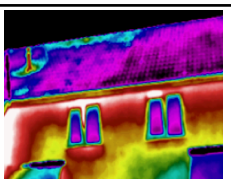
- Each image is calibrated from high to low and therefore if using a rainbow scale all images will show white/red as hot and black/blue as cold. The scale reference on the picture shows the top and bottom temperatures.
- The image is designed to show relative temperatures for the house. It is not comparable with other houses. The difference in temperature between different parts of the image shows the extremity of the heat loss e.g. look for colour differences across a wall or other surface.

- Consider how different materials can appear to be different colours even though they are the same temperature because they are better or worse at emitting infra-red light e.g. bare breeze-block compared to white painted render. Metal has lower emissivity so may appear colder than it really is.
- Crucially white and dark red points/areas in the images highlight areas of concern where heat is being lost.
- Windows, glass and most roofs reflect infra-red light and so appear in pictures as colder than they actually are as they are showing reflections of the sky.

Detailed interpretation guide

Radiators – Look out for hot spots where radiator are leaking heat through the wall from poor insulation behind them *(under the windows in image)*. **Bay windows** – Double bays are often uninsulated below the windows and there is seldom any insulation in the roof of single bays.	
Uninsulated walls – Cavity walls may not be insulated. Solid walls are often uninsulated *(image shows house with cavity wall insulation on right compared to neighbours on left)*.	
Sheltering effect – patches under the eaves, window ledges, sheltered corners and under porches *(as in image)* will appear slightly warmer than the rest of the wall as the air isn't circulating so much.	
Thermal bridges – there may be hotter areas due to thermal bridges crossing the cavity wall made by structures such as lintels over windows *(shown red in image)*, or at the intersection between upstairs and downstairs. Corners are a particular type of thermal bridge. They will be warmer than the main wall when seen from outside. These are structural issues which cannot be easily addressed.	
Extensions – modern extensions may appear colder *(as in image)* than the main house as cavity wall insulation better than it used to be. Extensions over 20 years old may be made of uninsulated solid wall and so will appear warmer.	
Poor insulation – inconsistencies in the temperature of walls may be due to patchy cavity wall insulation or places around structural features like windows where it might not have reached.	

Heat exchangers and other anomalies – extractor fans, air bricks and vents will show up hotter than the wall *(see white spots in image)* as they are exchanging warm internal air with the outside (some degree of ventilation is needed in a house). Outside lights or boiler flues will also show up hot and need careful interpretation as will give a false high reading therefore skew the rest of the image. A hot stripe along the wall may be the drain from sink or bath.	
Windows – glass reflects infra-red light meaning that upstairs windows often show reflections of the cold sky, or trees etc *(top image)*. Dormer or velux will almost certainly reflect the sky and can show on the image as an extreme low, skewing the image. However, many houses with dormer windows appear to show heat loss where the dormer enters the roof. Sometimes windows do show some heat from the window itself and is likely to be hotter towards the edges of the glass *(middle image)*, corresponding to the places on the inside where condensation starts to form. High performance window such as triple glazed windows *(the left hand window in bottom image)* will appear significantly better insulated, thus colder.	  
Patio doors/French windows – these can often appear hotter than windows *(note white frames loosing heat on image)*.	
Window frames – hot spots on the frames might indicate drafts or breaks in the window seal *(white line on left of image)*. Many modern window have air vents above the window which show up as obvious hot lines. You can easily see hot air pouring out of open windows.	
Doors – compare the door with the surrounding walls and check for hotter lines around the edges, cat flaps and letter boxes indicating draughts, as well as any glass in the door which might be reflecting the infrared light. However, if the door was recently opened to it might be hotter around the edge where it was open *(see top left corner of door)*.	
Porches – over the door shelters or porches will provide some sheltering and so the door may be a few degrees warmer underneath.	

Roofs – because they reflect the sky, roofs will look colder than the walls. You can compare the temperature within the roof itself, but not with the walls. Look for hot spots along the ridge *(as in image)* which might indicate warm air in the loft cavity i.e. not enough loft insulation. If the temperature under the eves is more than a few degrees warmer than the normal sheltering effect, it might indicate hot air escaping from the loft cavity due to lack of loft insulation. Hot spots might indicate flues *(as in image)* or hot water tanks.	
Double & single story roofs – look for warmer patches in areas that might not have been insulated well such as at the transition between single and double stories or in the roofs of single story extensions or entrance halls.